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Attorney Docket No.: OPP-GZ-2007-0072-US-00

**IN THE UNITED STATES PATENT & TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

IN RE APPLICATION OF:

Kang-Hyun LEE

SERIAL NO: 10/728,706

FILED: December 5, 2003

**FOR: METHOD FOR FABRICATING
METAL LINE OF
SEMICONDUCTOR DEVICE**

[illegible]

GROUP ART UNIT: 2813

EXAMINER: Tuan H. NGUYEN

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By:

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REPLY BRIEF

SIR:

Appellant submits this Reply Brief to the Board of Patent Appeals and Interferences in response to the Examiner's Answer mailed March 30, 2007 to support the Appeal filed on July 31, 2006 in the above-referenced patent application.

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ADDITIONAL ARGUMENTS IN SUPPORT OF CLAIMS 1, 18, AND 20-22

With respect to the first ground of rejection (i.e., of Claims 1, 3, 4, 18, and 20-22 under 35 U.S.C. § 103(a) as being unpatentable over the Background as described in the present application in view of Chung), Appellants respectfully point out the following errors in the Examiner's logic and reasoning in the Examiner's Answer with regard to Groups I and II.

1. Appellant's Use of the Term "Conventional" Is Not an Admission of Prior Art

The term "conventional" as used by Appellant refers to knowledge or technology that is outside the scope of the present invention, but that was in existence at the time the application was filed. The existence of such knowledge or technology at the time of the present invention is not known, although its existence at the time of filing the application is known. Furthermore, it is not known from the Background section of the present application whether such knowledge or technology was concealed or published, or whether such knowledge or technology was the work of "another." Thus, Appellant's description of conventional knowledge or technology is not an admission that such knowledge or technology constitutes "prior art" under 35 U.S.C. 102. The Examiner's reliance on Appellant's Background section of the present specification constitutes a reversible error.

2. Chung et al. Is Silent with Regard to Actual Photoresist Thicknesses

It is true that Chung et al. discloses "a photoresist layer having a lower thickness" (col. 1, l. 27), but lower than what? Chung et al. sheds no light on this statement. Based on the evidence of record, only the present application discloses a photoresist thickness of 9000 Angstroms.

Chung et al. states:

"Prior art light sources with lower wavelengths are normally used in a high-resolution photolithographic process. In addition, the depth of focus of a high-resolution photolithographic process is shallower compared to a relative low-

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resolution photolithographic process. As a result, a photoresist layer having a lower thickness is required for conventional photolithographic methods. However, a photoresist layer having a lower thickness is susceptible to the subsequent etching steps in a semiconductor manufacturing process. This relative ineffective resistance to etching reduces the precision of patterning and defining of a photoresist. These limitations prevent the dimensions of patterns on a photoresist from being reduced." (Col. 1, ll. 22-35.)

Thus, although Chung et al. discuss the need for a relatively "thin" photoresist and a problem associated therewith (relative ineffective resistance to etching), Chung et al. is silent with regard to actual photoresist thicknesses. But, when it is convenient for the photoresist thickness to be inherently less than 9000 Angstroms (i.e., when that thickness must be found in the prior art), it is inherently less than 9000 Angstroms, and when it is convenient for the photoresist thickness to be greater than 9000 Angstroms (i.e., when relying on Appellant's Background of the Invention from the present specification), it is not. The Examiner's inconsistent position with regard to photoresist thickness constitutes a reversible error.

3. Chung et al. Did Not Face the Problem of the Present Inventor

In addition, Chung et al. is not concerned with one of the problems that faced the present inventor, namely that of metal stringer formation (see p. 7, ll. 12-18 of the Examiner's Answer). Chung et al. does not discuss any problems associated with relatively "thick" photoresist other than to suggest that there might be a depth of focus problem if the photoresist does not have a "lower thickness," whatever that might mean. Thus, it is not true that Chung et al. recognized the same problem as the inventor. Chung et al. appear to try to balance etching resistance with depth of focus, whereas the present inventor balances etching resistance with formation of metal stringers.

As one might imagine, metal stringers are formed only when etching metal. One cannot form metal stringers when etching polysilicon or a dielectric material, which are two other materials on which Chung et al. focus their patterning and etching process (see, e.g., the Abstract in its entirety and col. 2, 64-67). Dielectric layers cannot cause short circuits when "stringers"

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are formed because a dielectric, by definition, is not conductive. In addition, there is no evidence on the record to establish that polysilicon has a "stringer" problem when etched using a "thick" photoresist as a mask. Thus, because Chung et al. is not specific about the material for layer 110 (i.e., it can be a polysilicon, dielectric or metal layer), Chung et al. is not concerned with the metal stringer problem faced by the present inventor.

The assertion that it would have been obvious to those skilled in the art to recognize the problems such as metal bridges or metal stringers associated with the use of thick photoresist as a mask without a buffer layer are overcome by using the buffer layer over the patterned photoresist having reduced thickness as suggested by Chung (p. 9, ll. 3-13 of the Examiner's Answer) is the epitome of hindsight reconstruction. The only evidence of record addressing the problems of metal bridges or metal stringers is the present application. As discussed above, Chung et al. does not address metal stringers because Chung et al. is concerned with depth of focus instead. In addition, one of the three materials of Chung et al. to be etched cannot have a stringer problem, and based on the evidence of record, another material is not known to have a stringer problem. Such assertions should not and cannot take the place of evidence, which Appellant has submitted to support the patentability of the present claims in the form of a sworn Declaration.

The assertion that it would have been obvious to those skilled in the art to lower the photoresist thickness to less than 9000 Angstroms and cover the thin photoresist with a buffer layer as suggested by Chung (p. 10, ll. 4-9 of the Examiner's Answer) is further evidence of hindsight reconstruction. The only evidence of record suggesting lowering the photoresist thickness to less than 9000 Angstroms is the present application (and not the "Background" section thereof).

4. The Lee Declaration Establishes Unexpected Results

Appellant's undersigned representative thanks Examiner Nguyen for citing *In re Woodruff*, *Titanium Metals Corp. v. Banner* and *In re Aller* for the proposition that obviousness may exist if the ranges are close enough that one would not expect a difference in properties (p.

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10, ll. 16-21 of the Examiner's Answer). By logical extrapolation, this statement appears to imply that since the present claims are found obvious by the Examiner, one would not expect the claimed photoresist thickness range (less than 9000 Angstroms) to provide a difference in properties relative to a photoresist thickness of greater than 9000 Angstroms. However, the Declaration of Kang-Hyun Lee, filed on January 12, 2006, states that the present method produces unexpected improvements in defect reduction (e.g., from a process with commercially unacceptable levels to [a process with] commercially acceptable levels; see paragraphs 15 and 22 of the Lee Declaration; emphasis added). This improvement is one of statistical and practical significance, in the absence of evidence to the contrary. The apparent oversight by the Examiner of such results -- and the evidence thereof -- is a reversible error.

Simply put, the unsupported statement by the Examiner at p. 10, ll. 9-14 cannot take the place of evidence. No reference is cited, and no Declaration or other sworn statement is made of record, to support the assertion that the thickness of photoresist layer must be within the claimed range in order to pattern a metal line having an opening (or spacing) of less than 0.26 micron by dry etching with the use of a buffer layer over a patterned photoresist having reduced thickness, due to the limitations of current photolithography with respect to resolution and depth of focus. The only disclosure of the specific number "0.26 micron" is the present application, and the only evidence of a photoresist layer thickness within the claimed range is the present application (and not the "Background" section thereof). This is classic hindsight reconstruction.

The assertion that it "would have been obvious to one having ordinary skill in the art to select a suitable thickness for the photoresist and buffer layers in order to obtain the optimum result" betrays a belief that there can be no unexpected results. In apparent furtherance of this apparent belief, the Examiner cites *In re Rau*, 117 USPQ 215 (CCPA 1958), for the premise that a patent cannot be granted for an applicant's discovery of a result, even though it may be unexpectedly good, which would flow logically from the teaching of the prior art. Presumably, this is true when the invention has not been read into the prior art, and when there is true inherency regarding the result. In the present case, the statements in support of the Examiner's belief betray a fundamental misunderstanding of the technology and the law.

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For example, the Examiner states that one of the skilled in the art would expect all problems such as metal stringers and notching associated with thick and thin photoresist in a dry etching process for forming an opening in a metal layer would be inherently eliminated when combining a buffer layer over a photoresist having a lower thickness, as required by Chung. The view that success (or in this case, unexpected results) would have been "inherent" cannot substitute for a showing of reasonable expectation of success (or in this case, reasonable expectation of the observed results). Inherency and obviousness are entirely different concepts. *In re Rinehart*, 531 F.2d 1048, 189 U.S.P.Q. 143 (CCPA 1976), citing *In re Spormann*, 53 CCPA 1375, 363 F.2d 444, 150 USPQ 449 (1966); *In re Adams*, 53 CCPA 996, 356 F.2d 998, 148 USPQ 742 (1966).

Inherency may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient. *In re Oelrich*, 666 F.2d 578, 581 212 USPQ 323, 326 (CCPA 1981). Furthermore, when a reference is silent about the asserted inherent characteristic, as Chung et al. is about photoresist thickness and metal stringer formation, such gap in the reference may be filled with recourse to extrinsic evidence. Such evidence must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. *EMI Group N. Am., Inc. v. Cypress Semiconductor Corp.*, 268 F.3d 1342; 60 USPQ2d 1423 (Fed. Cir. 2001), emphasis added, quoting *Continental Can Co. v. Monsanto Co.*, 948 F.2d 1264, 1268; 20 USPQ2d 1746, 1749 (Fed. Cir. 1991).

However, the results in the Lee Declaration do not state that metal stringers are eliminated. Instead, defects associated with metal stringers (and with dry etch damage to an upper surface of metal lines) are simply reduced, from commercially unacceptable levels to commercially acceptable levels, and one of ordinary skill in the art would not understand or appreciate from reading Chung et al. and Narita (the remaining cited reference) that the claimed method would provide the observed improvements in defect reduction (see paragraphs 14-15, 19, and 21-22 of the Lee Declaration). Thus, the Examiner's statement that metal stringers and notching associated with thick and thin photoresist in a dry etching process for forming an

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opening in a metal layer would be inherently eliminated when combining a buffer layer over a photoresist having a lower thickness is factually inaccurate, based on the evidence in the Lee Declaration. (Plus, the Examiner's statement makes little common sense -- is it generally accepted in the semiconductor industry that all defects, even of a certain type, can be inherently eliminated in a manufacturing process? Such a statement appears to be somewhat inconsistent with the general understanding in the industry, and should be supported by evidence if it is to have any weight.)

As discussed above, the Examiner has instead relied on statements unsupported by evidence to support the "obvious that it would be inherent" assertions made throughout the Examiner's Answer. In fact, actual evidence (as discussed above) demonstrates that the results provided by the present invention are unexpected, not inherent. Increasing the thickness of a photoresist layer (as the present inventor did by adding a buffer layer to the photoresist) might be expected to cause a metal stringer problem, as disclosed by Applicant's Background in paragraph [0012]. The cited art is silent with regard to reducing metal stringer formation, so the results described in paragraphs 15 and 22 of the Lee Declaration are unexpected.

In addition, there is considerable case law that supports a finding of non-obviousness when evidence of unexpected results is provided to the USPTO. "(A) greater than expected result is an evidentiary factor pertinent to the legal conclusion of obviousness ... of the claims at issue." *In re Corkill*, 711 F.2d 1496, 226 USPQ 1005 (Fed. Cir. 1985). Secondary considerations are essential components of the obviousness determination. *In re Rouffet*, 149 F.3d 1350, 47 U.S.P.Q.2d 1453 (Fed. Cir. 1997). This objective evidence of nonobviousness includes copying, long felt but unsolved need, failure of others (*In re Rouffet*, citing *Graham v. John Deere Co.*, 383 U.S. 1, 17-18, 15 L. Ed. 2d 545, 86 S. Ct. 684 (1966)), commercial success (*In re Rouffet*, citing *In re Huang*, 100 F.3d 135, 139-40, 40 U.S.P.Q.2d 1685, 1689-90 (Fed. Cir. 1996)), unexpected results created by the claimed invention and unexpected properties of the claimed invention (*In re Rouffet*, citing *In re Mayne*, 104 F.3d 1339, 1342, 41 U.S.P.Q.2d 1451, 1454 (Fed. Cir. 1997); and *In re Woodruff*, 919 F.2d 1575, 1578, 16 U.S.P.Q.2d 1934, 1936-37 (Fed. Cir. 1990)). Given that the art does not discuss or suggest metal stringer formation or the

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expectation that one should or would have if one adds a buffer layer to a photoresist having a thickness of less than 9000 Angstroms, the results described in paragraphs 15 and 22 of the Lee Declaration are unexpected.

Factually, the assertion that "it would have been obvious to one having ordinary skill in the art to recognize that a photoresist of less than 9000 Angstroms is inherently required to form an opening of 0.02 microns [it is believed that "0.2 microns" is meant] with precision" is inconsistent with the finding that Appellant's Background discloses a photoresist with a thickness of more than 9000 Angstroms. The Examiner has recognized this latter finding when a metal line having a CD less than 0.23 microns is formed (see p. 7, ll. 2-7 of the Examiner's Answer). This inconsistency raises a significant question regarding the Examiner's statement regarding the obviousness of "a photoresist of less than 9000 Angstroms [being] inherently required to form an opening of 0.02 microns with precision" (p. 4, paragraph 3, of the Examiner's Answer; emphasis added).

If the photoresist of less than 9000 Angstroms is inherently required to form an opening of 0.2 microns with precision, then the technology described in Appellant's Background may not exist and/or may not be enabled. As a result, Appellant's Background should not be relied on to reject the present claims. On the other hand, if a photoresist with a thickness more than 9000 Angstroms can be used when forming a metal line having a CD less than 0.23 microns, then it is not inherent that a photoresist of less than 9000 Angstroms thickness is required to form an opening of 0.2 microns (presumably between metal lines). The Examiner's inconsistent positions betray an intent to find the present invention obvious, regardless of the facts or the law.

5. The Lee Declaration Contains Evidence Supporting Patentability

The Examiner's statement at p. 12, ll. 3-5 that Appellant's arguments or conclusory statements unsupported by factual evidence are insufficient to establish unexpected results betrays the Examiner's oversight with regard to Appellant's factual evidence of unexpected results (see paragraphs 15 and 22 of the Lee Declaration). Evidence traversing rejections must

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be considered by the examiner whenever present. All entered affidavits, declarations, and other evidence traversing rejections are acknowledged and commented upon by the examiner in the next succeeding action. M.P.E.P. § 716.01; emphasis added. Affidavits or declarations containing evidence of criticality or unexpected results... must be considered by the Examiner in determining the issue of obviousness of claims for patentability under 35 U.S.C. 103. M.P.E.P. § 716.01(a); emphasis added. As indicia of obviousness or unobviousness, such evidence may have relevancy. M.P.E.P. § 716.01(a), citing *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966); *In re Palmer*, 451 F.2d 1100, 172 USPQ 126 (CCPA 1971); and *In re Fielder*, 471 F.2d 640, 176 USPQ 300 (CCPA 1973). The Examiner's apparent lack of consideration of the factual and/or opinion evidence contained in the Lee Declaration is reversible error.

ADDITIONAL ARGUMENT IN SUPPORT OF DEPENDENT CLAIMS 3-4

The silence of the Examiner's Answer regarding dependent Claims 3-4 (Groups III and IV in this Appeal) is believed to speak to the strength of Appellant's separate arguments in support thereof.

CONCLUSION

Thus, the rejections of the claims in the present application are reversible error, under the provisions of 35 U.S.C. § 103(a). Consequently, the present claims are in condition for allowance.

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For the reasons advanced above and as set forth in the Appeal Brief filed November 30, 2006, Appellant and his undersigned representative respectfully urge that the rejections of Claims 1-18 and 20-22 as being obvious under 35 U.S.C. §103(a) are improper. Reversal of the rejections is respectfully requested.

Respectfully submitted,



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